The Mountain Pine Beetle[1]

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The mountain pine beetle, *Dendroctonus ponderosae* Hopk., is one of the most destructive forest insects in western North America. Infestations have almost totally depleted merchantable pine forests and, in some cases, have converted valuable forests to less desirable timber species.

Characteristics of mountain pine beetle infestations differ with the host species and the age and density of affected stands. In mature stands of western white, sugar, and ponderosa pines, single trees or small groups are usually attacked, and tree killing takes place over a fairly long period of time. In second-growth stands of these same species, especially where trees are dense and just reaching young merchantable size, groups of several hundred trees may be killed during a single season.

Outbreaks in lodgepole pine are generally confined to stands that contain at least some trees of large diameter. These outbreaks can be extremely severe over extensive areas.

Throughout most of its range, the mountain pine beetle, alone, kills infested trees; in the southwestern United States, however, this beetle is frequently associated with other *Dendroctonus* species that may be chiefly responsible for tree mortality.

The beetle is found over a wide area from the Pacific Coast eastward through the Black Hills of South Dakota and from northern British Columbia and western Alberta southward to northwestern Mexico (fig. 1). Its habitat ranges in altitude from 2,000 feet in the more northern latitudes to 11,000 feet in southern California.

Hosts

Western white, sugar, ponderosa, and lodgepole pines are the most important hosts. Whitebark and limber pines are attacked less

[1] Synonymy: Combines mountain pine beetle, *Dendroctonus monticolae* Hopk., and Black Hills beetle, *D. ponderosae* Hopk. *See* Wood, Stephen L. The Great Basin Naturalist 23(1–2); 57–69. 1963.

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U.S. DEPARTMENT OF AGRICULTURE
Forest Service
Revised September 1970

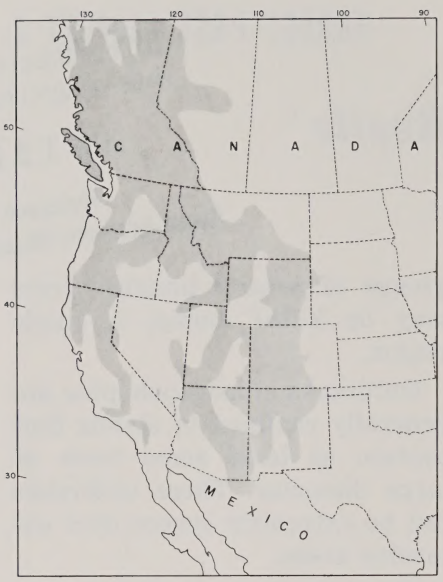

Figure 1.—Probable distribution of the mountain pine beetle in North America.

commonly. Pinyon, bristlecone, and foxtail pines are also known hosts, but infestations rarely occur in these species.

Trees other than pines, including spruce and fir, may occasionally be attacked and killed during severe mountain pine beetle outbreaks but are not considered to be hosts since no broods are produced in such trees.

Evidences of Infestation

The first signs of attack are pitch tubes on the tree trunk, marking the places where beetles have entered, and boring dust in bark crevices and around the base of the tree. Pitch tubes are dark-red to cream-colored masses of resin mixed with bark and wood borings. They are about ¼ to ½ inch in diameter.

A few weeks after attack, blue-staining fungi, carried into the trees by the beetles, discolor the sapwood. This is a certain indication that the tree has been successfully attacked and killed. Successfully attacked trees start fading a month to a year after attack, depending on tree species, season of attack, and weather. The needles change from green to yellowish green, sorrel, and finally rusty brown before dropping off. Fading may be the first indication of attack on large, mature sugar pines, since initial attacks on this species frequently occur high in the crown.

Description of Stages

The beetles pass through egg, larval, pupal, and adult stages (fig. 2). The minute, pearly-white eggs hatch into yellowish-white, legless grubs, or larvae. After passing through four instars, the larvae change into pupae and then into adults. Newly formed adults are yellowish white; they become tan to brown and are finally black at maturity. The adults are about 3/16 inch long.

Life History

The wide distribution of the beetle accounts for considerable variation in its life history. There is one generation annually in most of its range. Adults may attack trees from June to September, depending on host and climate. The resulting broods overwinter as young to mature larvae or as

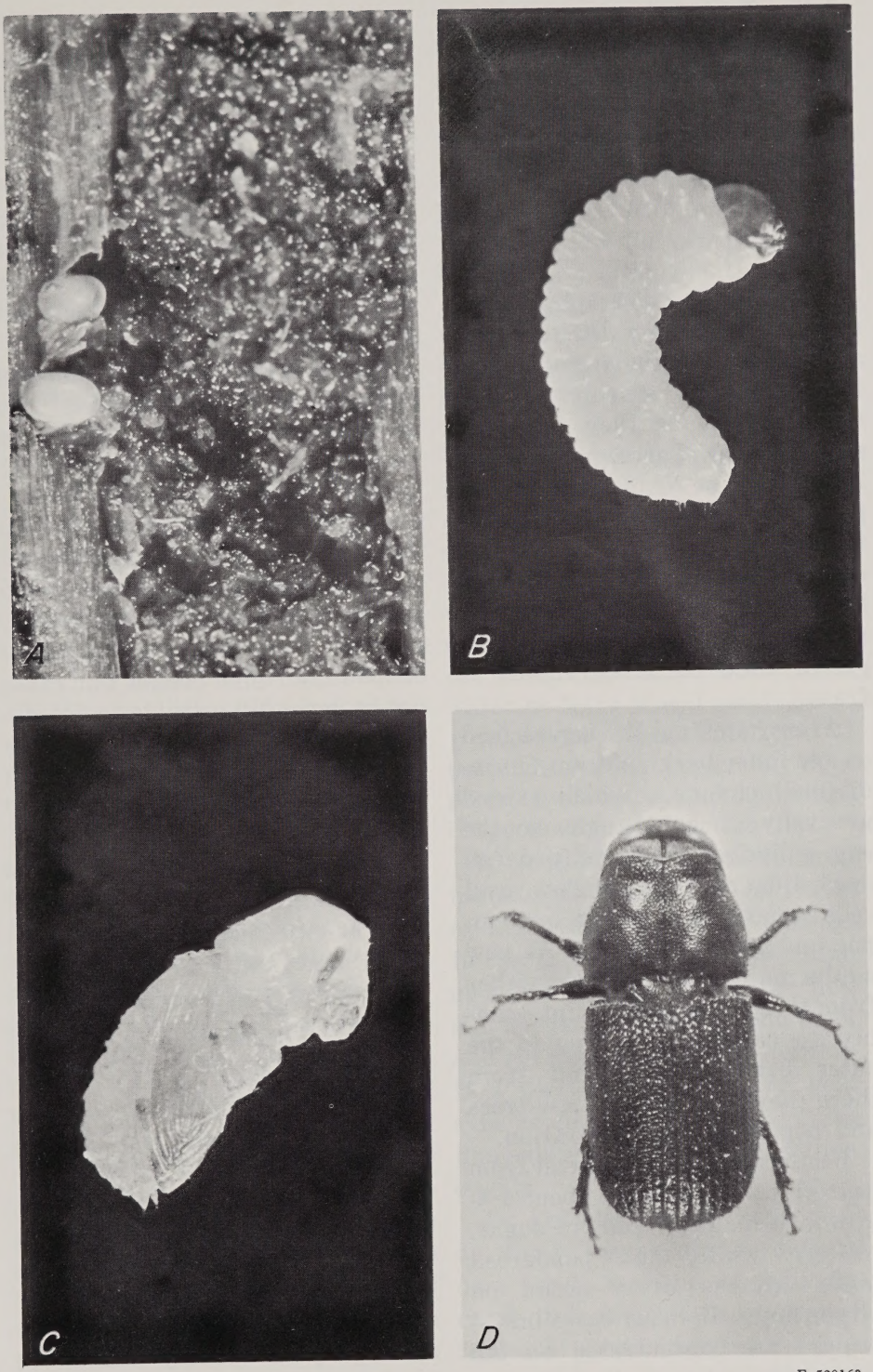

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Figure 2.—Mountain pine beetle: *A*, Eggs; *B*, larva; *C*, pupa; *D*, adult.

adults. Two and a partial third generations can develop each year in warm climates below an altitude of 7,000 feet in southern California. Where temperatures are exceptionally low, the life cycle may require 2 years.

Habits

Adult beetles attack by boring through the bark to the cambium area, then tunneling upward along the inner bark, scoring the sapwood slightly as they form the egg galleries. These galleries are roughly 12 to 30 inches long, depending on the host species. The females lay eggs in individual niches along each side of the gallery (fig. 2, *A*). The gallery is tightly packed with partially digested wood particles, known as frass.

After hatching, the larvae feed on the inner bark (phloem) in individual channels, which extend generally at right angles to the egg galleries. When fully developed, they excavate shallow, oval cells, where they change into pupae and later into adults. As new adults mature, they emerge either from these cells or from interconnecting cavities by boring to the outer bark surface, and from there they fly to attack new trees and begin another generation.

Beetle attacks may extend from near ground level up to about a 4- to 6-inch diameter top. In sugar, western white, and ponderosa pines, attacks often occur on larger limbs. In many cases initial attacks are concentrated on the lower trunk. Later other beetles, such as *Ips*, infest the rest of the trunk. Initial attacks may also occur in the crown, as in mature sugar pines.

Natural Control

Many natural factors assist in regulating mountain pine beetle populations. None of these, however, can be counted on to halt outbreaks.

Infrequently, sudden below-zero autumn temperatures or prolonged subzero winter temperatures may halt outbreaks. Nematodes effectively reduce beetle fecundity, and this, combined with the effects of one or more other natural enemies, can contribute to low beetle populations. Woodpeckers often help reduce populations of mountain pine beetles but cannot be depended on to do so. Predators such as the beetles *Enoclerus sphegeus* F. and *Temnochila virescens* (F.) and the fly *Medetera aldrichii* Wheeler reduce populations of the beetle to some extent. Parasites such as *Coeloides dendroctoni* Cushman sometimes contribute greatly to beetle mortality but only in thin-barked host trees. On rare occasions, high beetle mortality is believed to have been caused by disease.

Tree vigor may also play a role in natural control. Some trees produce resin in such quantities that unusually large numbers of beetles may be required to overcome them. Unsuccessful attacks on such trees are evidenced by large, creamy pitch tubes, and are known as "pitchouts."

Applied Control

Several direct control methods are used to combat mountain pine beetle outbreaks. The most important of these are use of chemicals, felling and burning infested trees, and salvage logging. Often more than one method is used in combating the insects in a single infestation.

Chemical treatment is the most generally employed control method. Two insecticides are equally effective, ethylene dibromide (EDB) and lindane.

EDB is generally used only on large-scale projects. It is prepared by mixing 1¼ gallons of 85-percent emulsified concentrate and ¾ gallon of emulsifier (1 pint Triton x-151 plus 5 pints Triton x-171) in 6 gallons of No. 2 fuel oil. It is applied with a low-pressure sprayer to the infested portions of standing or felled trees to the point of runoff.

Lindane, generally obtained as a 20-percent emulsifiable concentrate and mixed with fuel oil in a ratio of 1 part of concentrate to 14 parts of oil, is also applied to felled trees with low-pressure sprayers. Only enough is put on to wet the bark. Lindane is also effective as a preventive spray applied to high-value trees that are susceptible to attack.

Overmature, large-diameter trees, trees damaged by lightning, and windthrown timber may serve as reservoirs for outbreak populations, especially in old-growth, virgin stands. The hazard of beetle attacks is reduced when such material is removed by logging. Thinning dense stands of pole-size and larger ponderosa pines is also believed to reduce the hazard.

Pesticide Precautions

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or when they may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equip-

ment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

WARNING: Recommendations for use of pesticides are reviewed regularly. The registrations on all suggested uses of pesticides in this publication were in effect at press time. Check with your county agricultural agent, State agricultural experiment station, or local forester to determine if these recommendations are still current.

Disclaimer

Use of trade names is for information purposes and does not imply endorsement by the U.S. Department of Agriculture.

References

THE MOUNTAIN PINE BEETLE, AN IMPORTANT ENEMY OF WESTERN PINES. J. C. EVENDEN, W. D. BEDARD and G. R. STRUBLE. U.S. Dep. Agr. Circ. 664, 25 p., illus. 1943.

THE BLACK HILLS BEETLE (DENDROCTONUS PONDEROSAE HOPK.) M. M. BLACKMAN. N. Y. State College Forest. Tech. Pub. 36, Vol. 4 (4), 97 p., illus. 1931.

SUGGESTED GUIDE FOR THE USE OF INSECTICIDES TO CONTROL INSECTS AFFECTING CROPS, LIVESTOCK, STORED PRODUCTS, FORESTS AND FOREST PRODUCTS. U.S. Dep. Agr. Agr. Handb. 331. (In process of revision.)

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